classification (classification of systems)

1. no. of I/Ps and O/Ps

a) SISO

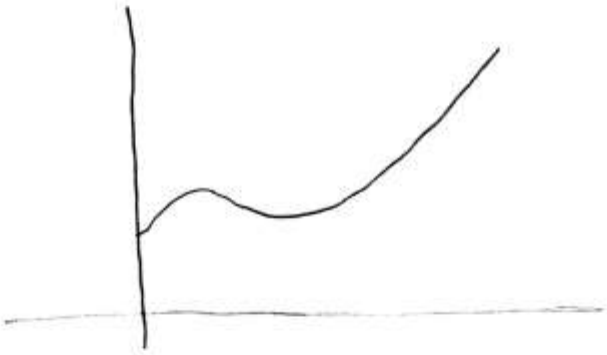
b) SIMO

c) MISO

d) MIMO

[2] Continously of signal

a) Cont.-time system



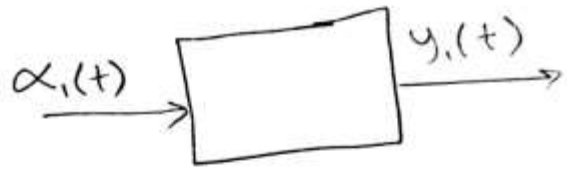
≡ Analogue system

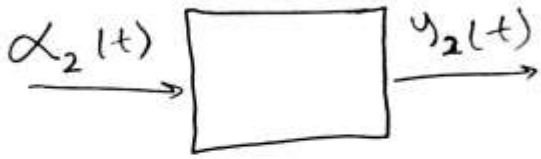
b) discrete-time sys.

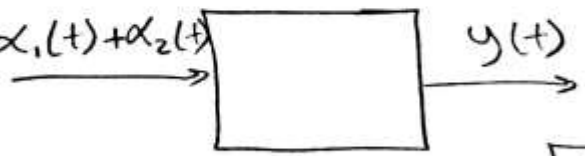
≡ digital sys.

[3] Linearity property :-

a) Linear sys.







if

$y(t) = y_1(t) + y_2(t)$

→ Linear sys.

if not

→ non Linear

b) non-Linear sys

4 Physical Comp.

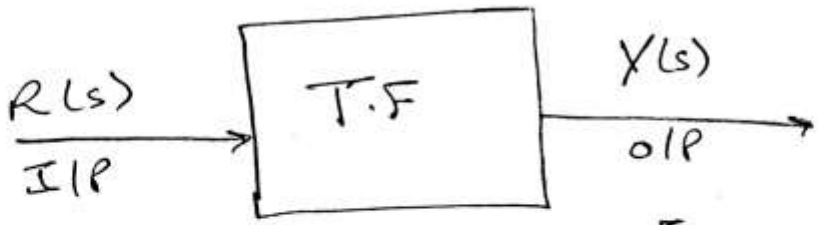
electrical | Mechanical | electro Mech | fluid

→ The system can be in the form of:-

- → Physical model
- → Block diagram or signal flow graph
- → state - space eqn.
- → system eqns.
- → Transfer function

System Response

→ o/p in time domain

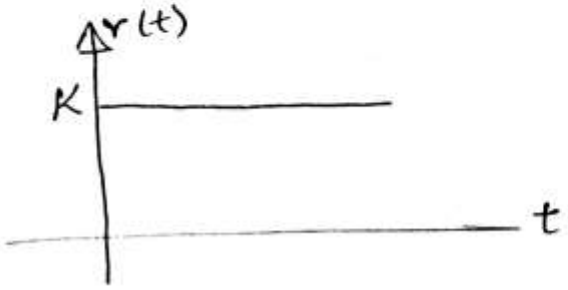


$$T.F = \frac{Y(s)}{R(s)} \Rightarrow Y(s) = [T.F]\, R(s)$$

$$\mathcal{L}^{-1}[Y(s)] = \mathcal{L}^{-1}[T.F * R(s)]$$

→ according to the i/p

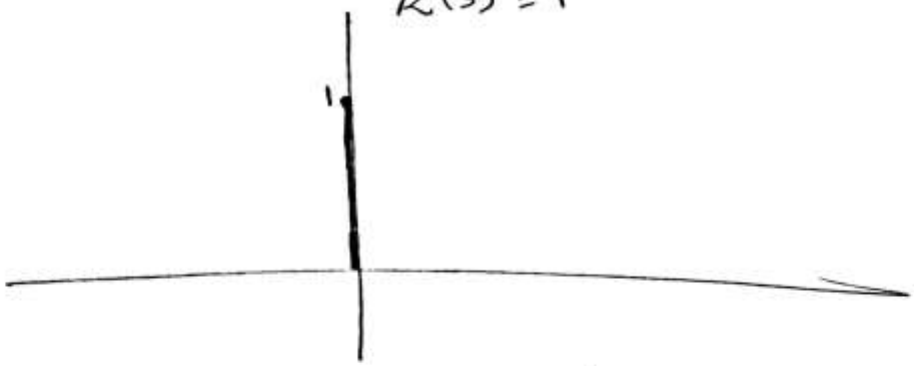
① step response $(r(t) = K)$



② Ramp Response $(r(t) = Kt)$

③ Parabolic i/p $(r(t) = Kt^2)$

④ impulse response $(r(t) = \delta(t))$



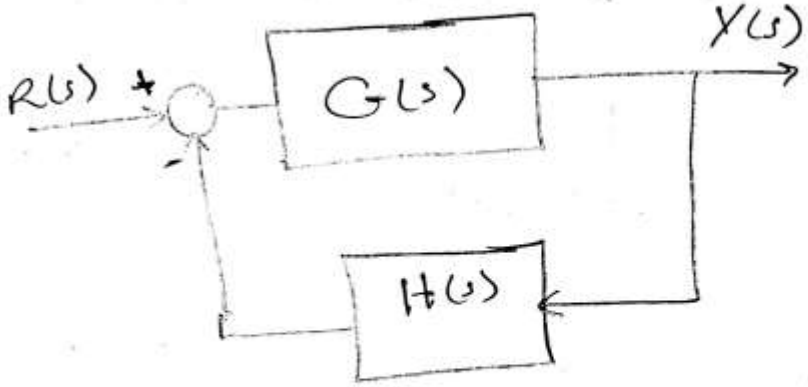
$$r(t) = \delta(t) = \begin{cases} 1 & t = 0 \\ 0 & \text{otherwise} \end{cases}$$

stability:

stable ⇒ for bounded i/p, there exist bounded o/p

Feedback system

$$T.F = \frac{G(s)}{1 + G(s) \cdot H(s)}$$



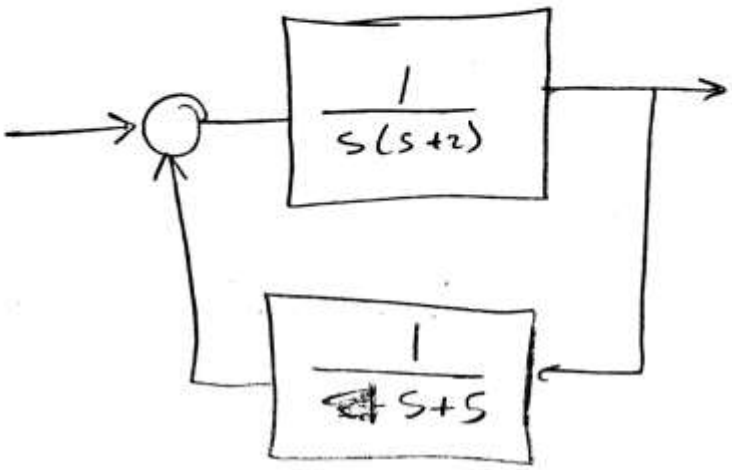
* Closed-loop T.F = C.L.T.F = T.F
* open loop T.F = O.L.T.F = G(s). H(s)
* ch. equation ⇒ 1 + G.H(s) = 0
* Poles ⇒ The roots of chlegn.
* Zeroes ⇒ The values of s' that makes G(s) = 0

* System type $\Rightarrow$ O.L.T.F

Ex

$$= \frac{1}{s^{(1)}(s+2)(s+5)}$$

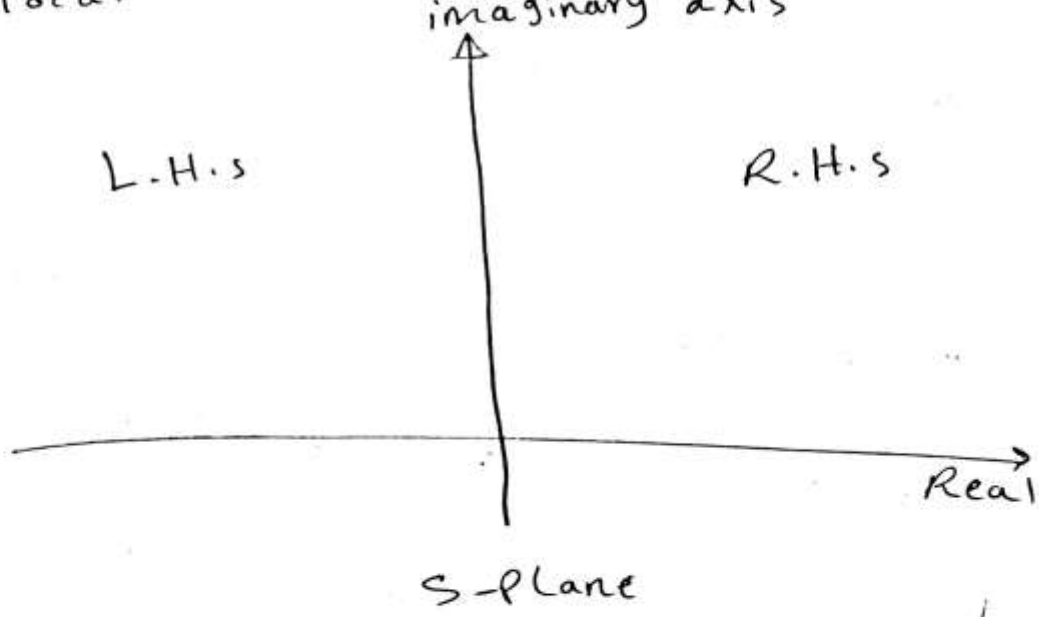
type = 1



* system order or system degree :-

$$\frac{1}{s(s+2)(s+5)} \Rightarrow \text{3rd order}$$

$\rightarrow$ To check the system stability using the poles location :-



← ليه لما إحتاج دختبر ال (stability) تعامل مع (Poles) وليس ال (Zeroes)

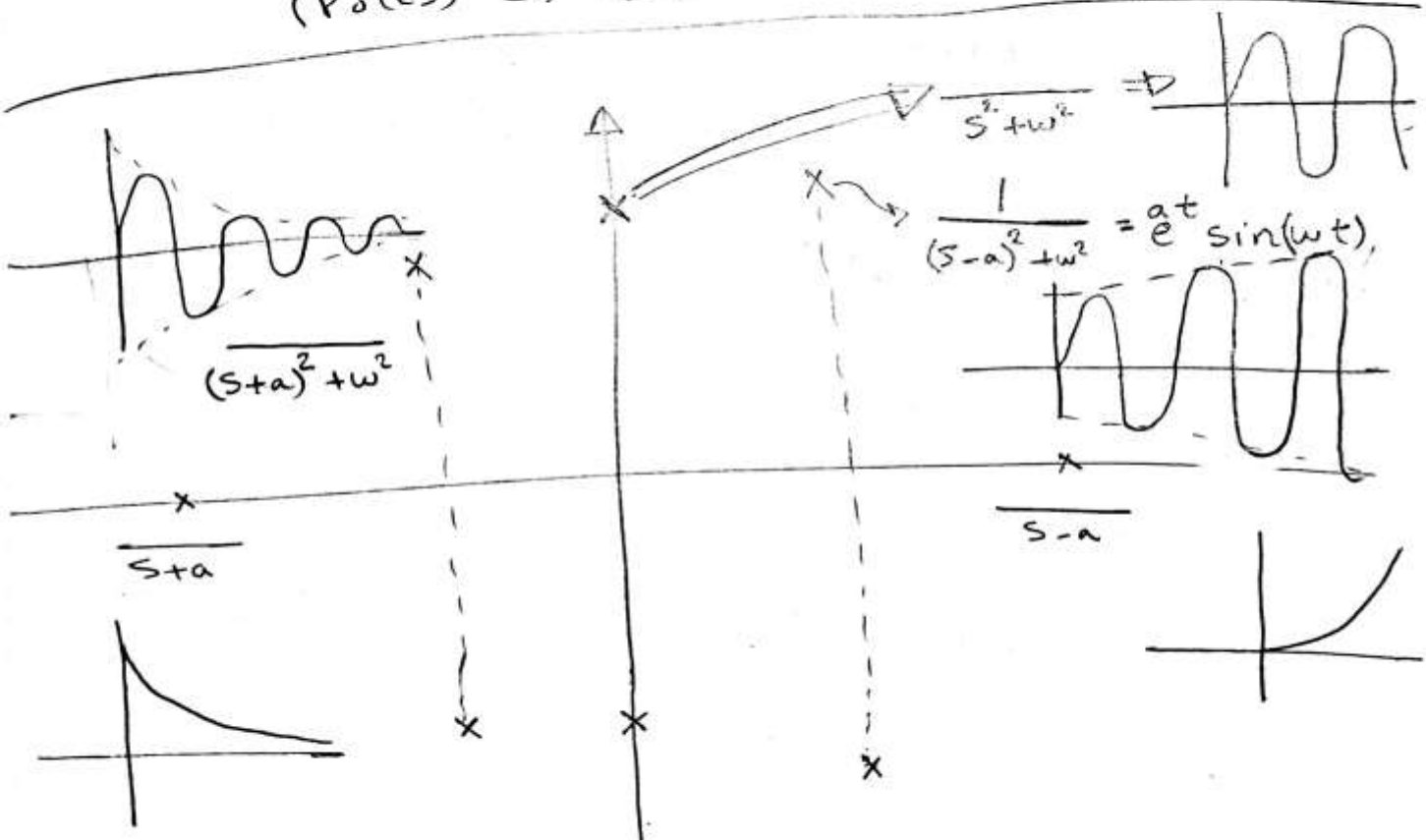
ex

$$T.F = \frac{s+2}{(s+3)(s+5)} \qquad R(s)=1$$

$$X(s) = \frac{s+2}{(s+2)(s+5)} = \frac{A_1}{s+3} + \frac{A_2}{s+5}$$

$$y(t) = A_1 e^{-3t} + A_2 e^{-5t}$$

← هنا ال (Zeroes) أعطاك رقم بيكبر أو بيوعز الرسم الناتج بس لكنه التأثير يكون بسبب ال (Poles)



→ To check the system stability

* Algebric
- Routh method.

graphical method
- Root locus
- Bode diagram
- Polar plot.

→ another classification :-

① Absolute stability
- Routh Array → stable
→ unstable
→ critically stable.

② Relative stability :-
→ Bode diagram
→ Polar Plot

ـ يجعلك تقرر مدى الـ (stability) للنظام

more stable or .....